March 25, 1947. W. C. GRAHAM 2,417,981

PORTABLE FLAME THROWER

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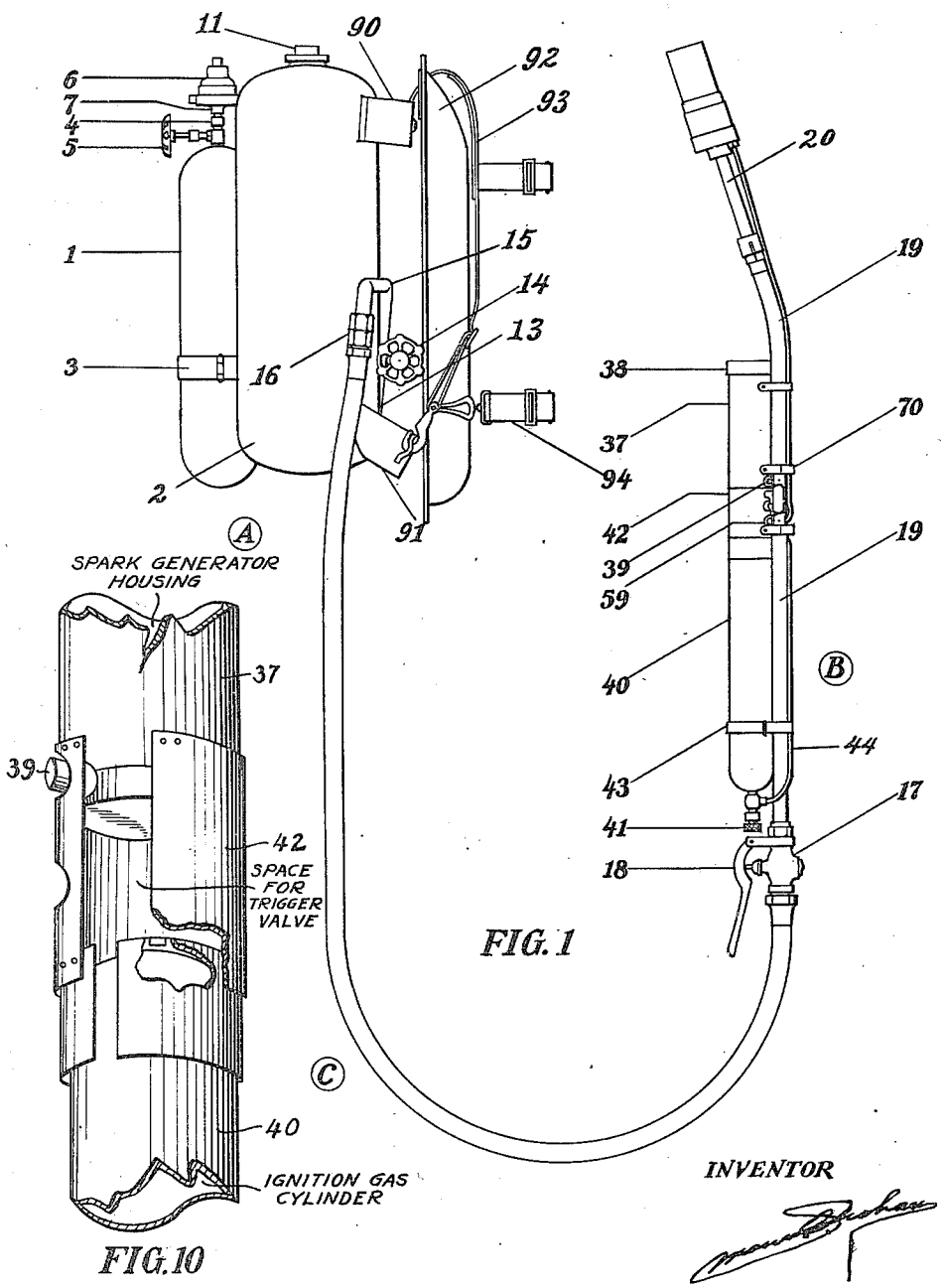


FIG. 1

FIG. 10

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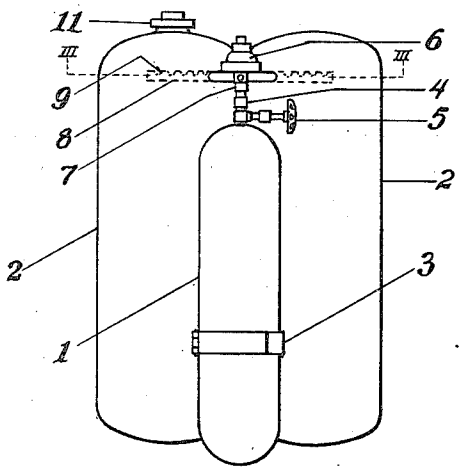


FIG. 2

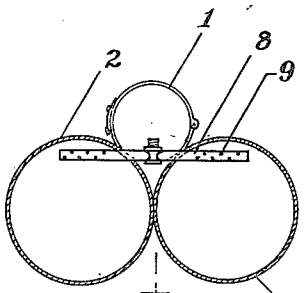


FIG. 3

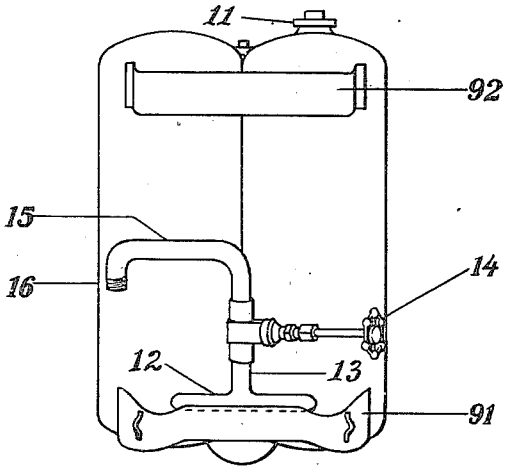


FIG. 4

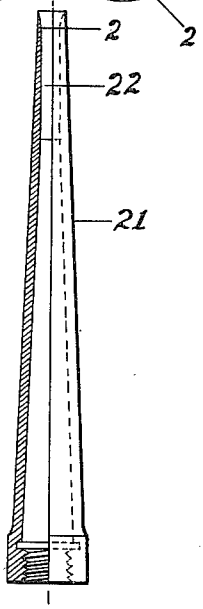


FIG. 5

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FIG. 6

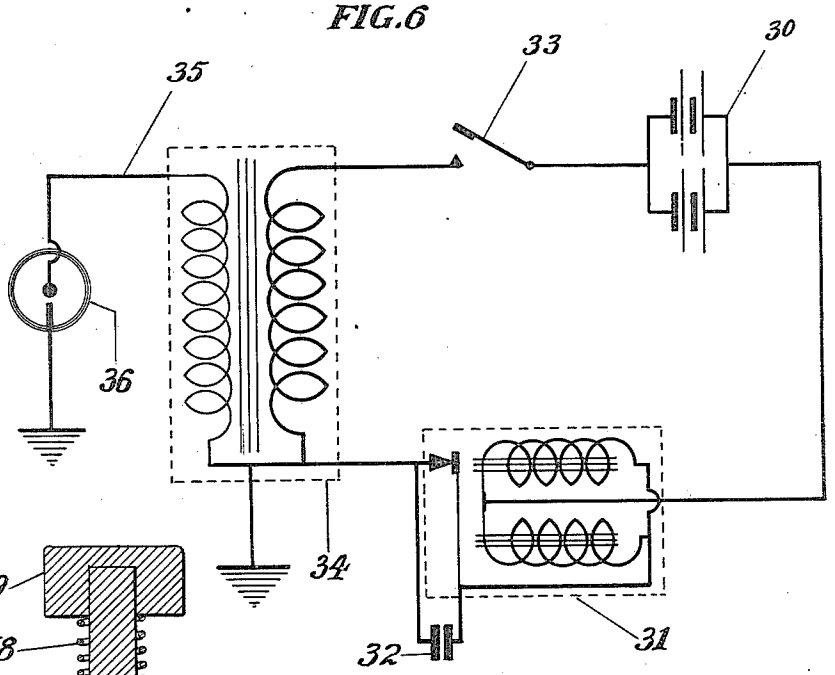
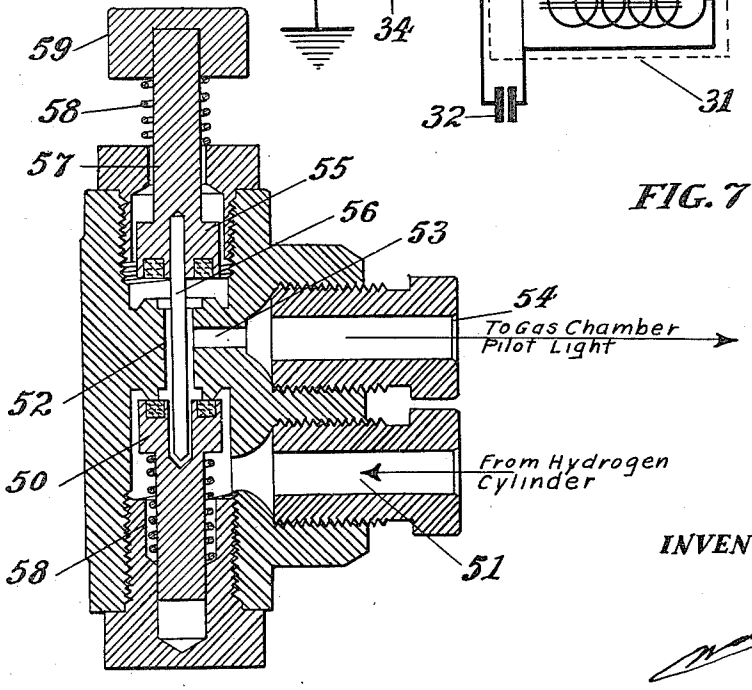


FIG. 7



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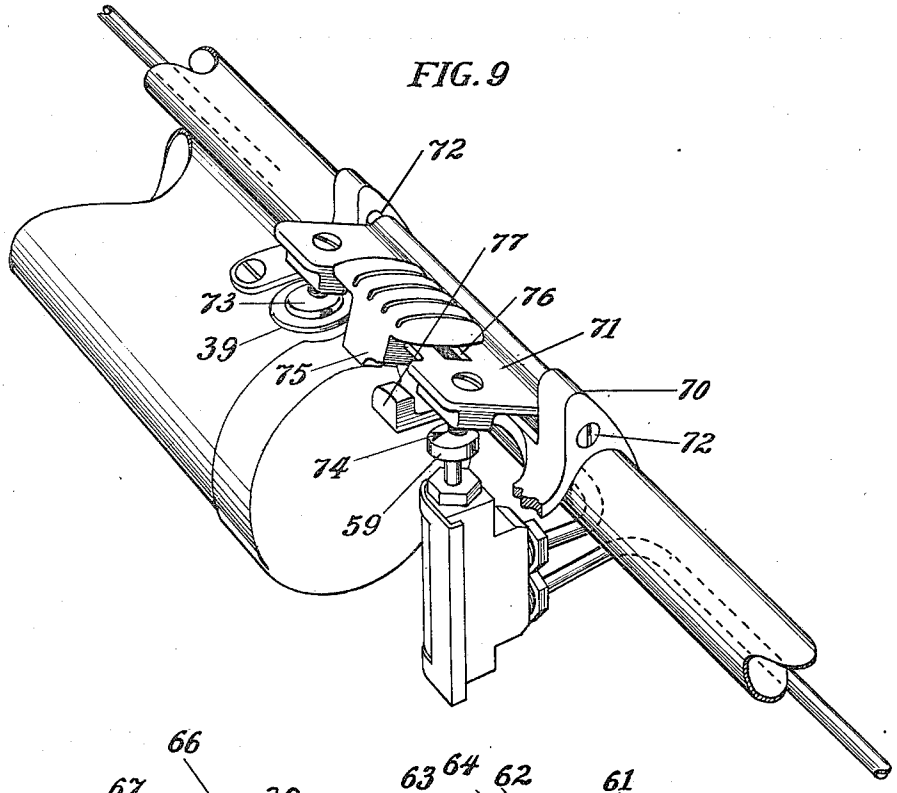


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FIG. 9



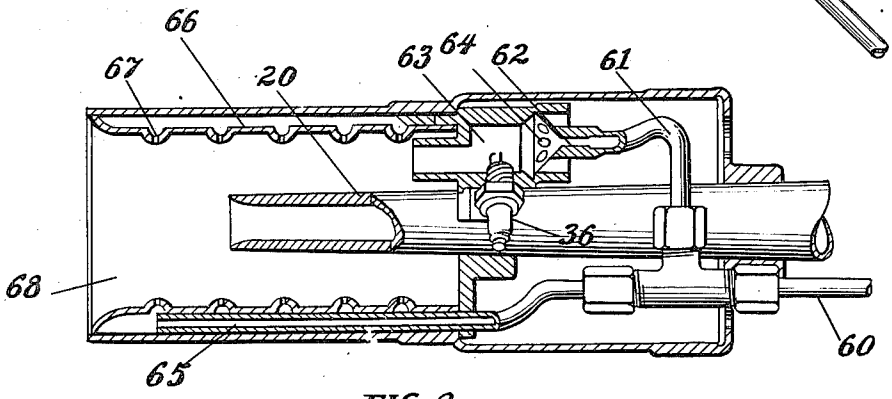


FIG. 8

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Patented Mar. 25, 1947 2,417,981

UNITED STATES PATENT OFFICE

2,417,981

PORTABLE FLAME THROWER

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Application February 26, 1942, Serial No. 432,443

8 Claims. (Cl. 158—28)

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This invention relates to flame throwers as used in warfare, and more particularly to flame throwers of the portable type.

It is one of the main objects of the invention to provide a portable flame thrower of greatly superior performance as compared to existing units, yet of such compactness that it may be carried and operated by a single individual.

It is a further object of the invention to provide a portable flame thrower having improved pressure distribution characteristics.

It is another object of the invention to provide a portable flame thrower with improved fuel ejection.

It is a still further object of the invention to provide a portable flame thrower having a quick-acting, reliable electrical ignition system.

It is still another object of the invention to provide a portable flame thrower including an improved ignition gas system.

Another object of the invention is to provide a portable flame thrower having incorporated a novel trigger valve, particularly adapted for the improved ignition gas system.

It is a further object of this invention to provide a portable flame thrower with a safety trigger controlling the ignition.

It is a still further object of the invention to provide a portable flame thrower with back equipment particularly adapted for ease in carrying.

Other objects, and the manner in which they are attained, will appear from the following description.

Broadly, the invention involves the provision of a portable flame thrower in two sections, one of which, i. e., the fuel unit, comprises the pressure system, part of the fuel system, and the carrying pack, while the other, the flame gun, includes the remainder of the fuel system, the electrical ignition system and the ignition gas system.

More specifically, the invention involves a pressure diffuser to distribute pressure in the fuel tanks; a fuel nozzle designed to yield maximum distance fuel ejection; a spark ignition system; an ignition gas system, including a pilot chamber; a trigger valve in the ignition gas system; a safety trigger controlling both the electrical and gas ignition systems; a gas cylinder clamp; a novel tank arrangement including two fuel tanks and a pressure tank located to the rear of and in between the fuel tanks; and a carrying pack comprising adjustable shoulder and waist straps and a cushion fastened to the bottom of the tanks.

In the drawings affixed to this specification and forming part thereof, one embodiment of the invention is illustrated diagrammatically by way of example.

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In the drawings—

Fig. 1 is a general view of the portable flame thrower as assembled;

Fig. 2 is a rear view of the tank unit;

Fig. 3 is a horizontal cross section along the line III—III in Fig. 2;

Fig. 4 is a front elevation of the tank unit;

Fig. 5 shows, partly in section, a fuel nozzle;

Fig. 6 is a wiring diagram of the electrical ignition system;

Fig. 7 is a section through the trigger valve forming part of the ignition gas system;

Fig. 8 shows, partly in section, a detail of the ignition gas system;

Fig. 9 is a perspective view of the safety trigger;

Fig. 10 is a perspective view, with parts cut away for clarity, of the spark generator housing and gas cylinder assembly.

Referring now to the drawings, wherein like elements are denoted by like symbols of reference, and first to Fig. 1, the portable flame thrower according to the invention is seen to comprise, generally, the fuel unit A, including the pressure system, part of the fuel system, and the carrying pack; the flame gun B, including the remainder of the fuel system, the electrical ignition system, and the ignition gas system; and the hose C, connecting units A and B.

As seen in Figs. 1, 2, 3, and 4, the pressure system comprises a pressure cylinder 1, mounted to the rear of and in between the fuel tanks 2, by means of the pressure cylinder clamp 3, adapted for ready replacement of the pressure cylinder.

Cylinder 1 connects to the rest of the pressure system at the pressure cylinder connection 4 which is controlled by the pressure cylinder valve 5. From the pressure cylinder connection 4, the gas flows through the pressure regulating valve 6, where the pressure is reduced from the variable cylinder pressure to a constant working pressure. A pressure safety valve 7, arranged on the regulating valve 6, is set so that it will blow whenever the working pressure is substantially exceeded. From the pressure regulating valve 6, the pressure system branches off to each of the fuel tanks 2, the gas entering at the top of these tanks through the pressure diffusers 8.

As illustrated in the drawing, the pressure diffusers 8 may comprise one or several pieces of pipe, the ends of which are closed and wherein holes 9, much smaller than the inside diameter of the pipe, are arranged at intervals, opening preferably toward the top of each tank and away

from the surface of the fuel stored underneath the diffusers.

In flame throwers, as heretofore designed, the pressure gas issued at the top of the fuel tank in a downward stream which tended to bore through the fuel column so as to pass out of the flame throwing nozzle in conjunction with the fuel. This resulted in an uneven stream of fuel being emitted from the nozzle resembling a fuzz, which in turn, placed a material limitation on the distance the flame could be thrown. This disadvantage is eliminated by the pressure diffuser according to the present invention, which, instead of blowing the expelling gas directly into the fuel, spreads it out towards the upper ends of the tanks, with the result that the gas is diffused throughout the voids above the fuel columns to bear down on the fuel evenly and without danger of boring through. Consequently, the fuel issues through the nozzle in an even undistorted flow so as to materially increase the distance the flaming fuel is thrown.

As shown in Figs. 1, 2, 3, 4, and 5, the fuel system comprises the two fuel tanks 2, arranged side by side, the fuel tank filling plug 11 provided in the top of one of the fuel tanks, the fuel header 12 arranged at the lower end of the fuel tanks and a fuel pipe 13 controlled by the fuel shut-off valve 14 and terminating in the bend 15 provided with the fuel hose connection 16. This connection serves as a means for disconnecting the flame gun from the fuel unit.

From the fuel hose connection 16, the fuel system extends to the flame gun through the fuel hose C, which is an oil resistant pressure hose lined with rubber, synthetic rubber or similar material.

The fuel hose C connects to the flame gun at the fuel discharge valve 17, which is of the seated quick opening type and is operated by the lever 18. The fuel system continues through the fuel pipe 19, forming the shaft of the flame gun, to the fuel nozzle 20.

The fuel nozzle is one of the most important elements of any flame throwing unit as its design is instrumental in determining the distance the flame is thrown. According to the present invention, as shown in Fig. 5, the interior of the fuel nozzle 20 is gradually reduced from the size of the fuel pipe 19, to a short distance from the orifice of the nozzle where the converging part 21 passes over into a straight part 22 terminating in the orifice 23. The orifice opening is slightly chamfered to produce a slight diverging effect at the orifice as the fuel leaves the nozzle. The interior of the nozzle is highly polished to yield optimum performance.

The provision, in the fuel nozzle according to this invention, of a gradually converging main part, followed by a short straight part terminating in the diverging orifice opening, results in preventing any eddy currents from being set up in the fuel during passage through the nozzle, which, if present, would cause distortion of the fuel stream emitted which, in turn, would materially reduce the distance the flame could be thrown. Consequently, the elimination of eddy currents and any other fuel stream distortion in the present nozzle assures effectiveness of the flame thrower over a materially larger distance than was heretofore obtainable.

Existing flame throwers, in the main, employ either one of two types of ignition. Most of the flame throwers used today in Europe, employ a fine resistance wire heated up for ignition purposes. This resistance wire type of ignition system suffers from the disadvantage that after it has been used once, oil is deposited on the wire to form a film or coating thereon. The next time the ignition is operated, this film or coating must first be burned off before effective ignition occurs, this removal of the oil deposit requiring as much as one minute. The fact that the operator is required to wait for the film to burn off the resistance wire before ignition takes effect, and this for a considerable period of time, renders the use of flame throwers of this type dangerous. Other flame throwers like the French, employ an improvised cigarette lighter for ignition purposes. This lighter cannot be relied upon at all times, particularly not if there is a strong wind.

The present invention provides an ignition system which completely eliminates the difficulties inherent in existing flame throwers and which assures immediate and reliable ignition at all times and under any conditions. This ignition system operates on the electric spark principle and comprises an electrical ignition system and an ignition gas system.

As shown in Fig. 6, the electrical ignition system comprises a primary circuit, including a battery 30, which may be a three-volt dry cell battery; a low resistance wound buzzer or interrupter 31; a condenser 32 connected to the interrupter; a switch 33, and the primary windings of a high tension transformer 34, producing for example, from 4000 to 6000 volts. The secondary circuit of the electrical ignition system comprises the secondary windings of the high tension transformer 34, the high tension ignition wire 35 and the spark plug 36, which may be of the miniature type used in model airplane or automobile engines.

Except for the ignition wire 35 and the spark plug 36, the electrical ignition system is contained in the water-proof housing 37, mounted on the shaft of the flame gun, as shown in Fig. 1; the cover 38 of this housing may be removed to change the battery. The ignition wire 35 leads out from the housing 37 to the spark plug 36 which extends into the pilot chamber of the ignition system, as described below. The switch 33 is operated by means of the push button 39 forming part of the safety trigger to be described below.

As shown in Figs. 1, 7 and 8, the ignition system further includes the ignition gas system serving the purpose of supplying a pilot flame and assisting in the ignition of the fuel. This ignition gas system comprises a gas cylinder 40 containing a supply of ignition gas such as hydrogen under pressure, for example, from 1800 to 2000 lbs. per square inch, and having a shut-off valve 41 whereby to release gas to the rest of the ignition gas system, only just previous to the time the unit is operated. The ignition gas cylinder 40 is attached to the flame gun by placing the dome end of the cylinder into the socket 42 formed by the base of the ignition housing 37, as shown in detail in Fig. 10, and securing the upper part of the cylinder to the flame gun shaft by means of the cylinder clamp 43, which, as described below in greater detail, permits of ready replacement of the ignition gas cylinder.

This arrangement evidently permits interchanging of ignition gas bottles so that a number of charged cylinders are kept on hand to replace the one used on the unit once it is empty. In

this manner, the unit may be serviced in the field instead of being required to be sent to a service station for the charging of the ignition gas bottles.

As seen in Fig. 1, the ignition gas passes from the cylinder valve 41 through a narrow tube 44 to the ignition gas trigger valve controlled by the ignition safety trigger to be described below.

This trigger valve is designed to automatically reduce the pressure prevailing in the ignition gas cylinder to a low operating pressure. As shown in Fig. 7, this valve is of a double acting type and comprises a first valve 50 controlling the passage of ignition gas from the inlet 51 through the passage 52 and the narrow bore 53, provided for pressure reduction purposes, to the outlet 54. A second valve 55 is operatively connected to the first valve 50 by means of a thin piston rod 56 extending through the passage 52 to seal this passage toward the stem 57 of the valve whenever the first valve 50 opens to admit gas to the outlet 54. Springs 58 and 58' acting on the two valves normally tend to keep valve 50 closed and valve 55 open. When the push button 59 connected to the twin valve unit is pressed down, gas is permitted to pass from the inlet to the outlet, its pressure being simultaneously reduced to a safe operating pressure, while gas is prevented from escaping through the stem of the valve. This arrangement results in a valve of extremely light construction, which, nevertheless, is capable of handling high pressure gas.

Leaving the outlet 54 of the trigger valve, the ignition gas passes through a tube 60 extending alongside the shaft 19 of the flame gun. As shown in Fig. 8, tube 60 divides into a pipe to the gas burner, to be described below, and a pilot gas pipe 61 terminating in a narrow bore 62. The bore 62 extends, somewhat off center, into the top of a pilot gas venturi 63, air admission openings 64 surrounding the bore 62 so that the suction effect caused by a jet of pilot gas being directed, slightly off center, into the pilot gas venturi draws in air to mix with the pilot gas. This combustible mixture is ignited at the spark plug 36 projecting into the pilot gas venturi.

The ignition gas pipe 60 also has a straight extension 65 extending into the jacket 66 having openings 67 through which the gas passes into the gas chamber 68 surrounding the discharge end of the fuel nozzle 20. Inasmuch as the pilot gas venturi 63 opens into the gas chamber 68, the combustible mixture ignited at the spark plug 36 passes into the gas chamber 68 and ignites the mixture of ignition gas, issuing through openings 67, and air, contained in the gas chamber, to result in a large flame whereby to ignite, in turn, the fuel discharged from the fuel nozzle 20.

The entire ignition operation, i. e., the supply of ignition gas, as well as the spark generation is controlled by the safety trigger 70 indicated in Fig. 1 and shown in detail in Fig. 9.

This safety trigger comprises an operating lever 71 mounted for rocking motion in bearings 72 and having two adjustable screws 73 and 74 projecting opposite the two push buttons 39 and 59, respectively, the distances between the ends of these screws and the corresponding push buttons being different and such that when the lever 71 is pressed down, push button 39 controlling the spark generation is operated first while the other push button 59, controlling the supply of ignition gas, is depressed only after the spark ignition is rendered operative.

To prevent lever 71 from being operated accidentally and unintentionally, a lock 75 is provided on this lever which may be moved in a slot 76, in the direction of the lever axis, to co-act with a stop 77 mounted on the base of the trigger 70. When this lock 75 is moved along operating lever 71 so that it comes to rest on the stop 77, the operating lever 71 cannot be pressed down, so as to render the entire ignition system inoperative. If it is desired to operate the ignition, the lock 75 is pushed in the reverse direction whereupon it will come to rest in between screw 73 and stop 77 so that now the operating lever 71 may be pressed down to first operate the electrical, and next the gas ignition systems. This safety trigger thus combines simplicity of construction and operation with complete assurance against accidental ignition.

One-man portability and ease in carrying are afforded the new flame thrower by the multiple tank arrangement and the carrying pack according to Figs. 1, 2, 3, and 4. The provision of two fuel tanks 2 arranged side by side, in place of a single tank of equal capacity, results in the accommodation of pressure tank 1 in the space between the two fuel tanks so as to render the unit far more compact than would otherwise be obtainable. In the front, this multiple tank arrangement utilizes the free space between the fuel tanks to accommodate the back of the carrier so that the unit may be carried more closely to the body, which again increases compactness and insures stability and a firm hold on the unit.

Carrying of the unit is further facilitated by the carrying pack according to the invention, which, moreover is especially adapted for quick and convenient putting on and discarding operations. As shown in Fig. 1, this carrying pack is attached to the fuel tanks 2 by an upper carrier bracket 90 and a lower carrier bracket 91 and comprises a back pad 92 secured to the lower bracket 91; shoulder straps 93 fastened to the upper bracket 90, passing through slots (not shown) in the back pad 92 and snapping on to the lower bracket 91; and a waist strap 94 snapped on to each side of the lower bracket and arranged for clasping together in the center. This carrying pack co-acts with the multiple tank arrangement in affording the operator a firm hold on the equipment when in use, lessening simultaneously its burden owing to the compactness of the unit, while permitting speedy putting on and removal operations.

The operation of the portable flame thrower according to the invention is as follows:

After opening valve 5 to admit pressure gas from the pressure cylinder 1 through the pressure diffuser 8 to the fuel tanks 2, and opening valve 14 to admit fuel from the fuel tanks 2 to the fuel discharge valve 17, and opening valve 41 to admit ignition gas from the ignition gas cylinder 40 to the ignition trigger valve controlled by push button 59, the flame gun is gripped with one hand on the fuel discharge lever 18 and the other on the ignition safety trigger 70. After sliding the locking lever 75 into a position where the catch 75 disengages the stop 77, the operating lever 71 is pressed down to result first in the generation of sparks at the spark plug 36, and next in the operation of the trigger valve to permit passage of ignition gas into the pilot gas venturi 63 where the pilot gas is ignited, followed by ignition of the combustible mixture in the gas burner 68. Now lever 18 may be operated to allow passage of fuel from the tank 2 to the

fuel nozzle 20 and into the open where the fuel is ignited by contact with the flame in the gas burner, fuel ignition taking effect at considerable distance from the flame gun so as to afford added protection to the operator. Once the fuel is ignited, the ignition operating lever 71 is released. Normally, the flame gun is operated intermittently to yield individual flame bursts of a few seconds duration each. Release of the fuel discharge lever 18 following release of the ignition operating lever 71 terminates the flame throwing operation; when no immediate further use is contemplated, the lever lock 75 is operated to secure the ignition operating lever 71 in inoperative position, whereupon the valves 41, 14 and 5 are shut to discontinue the passage of ignition gas, fuel and pressure gas into the unit.

Whenever necessary, the pressure gas cylinder 1 and the ignition gas cylinder 40 are replaced by full gas cylinders while the fuel tanks are filled through the filling plug 11.

In the field, a service kit containing spare parts, a supply of gas cylinders and a supply of fuel render the unit permanently available for action.

As the pressure gas, nitrogen is contemplated yet any other expelling agent may be used which will not react with nor dissolve in the fuel. While the pressure in the pressure cylinder may be about from 1800 to 2000 lbs. per square inch, for example, the operating pressure preferably should not exceed approximately 300 pounds per square inch as a higher pressure tends to atomize the fuel oil. A pressure in the neighborhood of 270 pounds per square inch may be used, for example.

The ignition gas preferred is hydrogen but any other highly inflammable gas such as acetylene, propane or butane, for example, may be employed.

A wide range of liquid fuel may be used in the portable flame thrower according to the invention. The fuel should contain high volatile fractions of oil to assist the ignition of the fuel, and low volatile fractions to provide slow burning and range.

The portable flame thrower according to this invention offers numerous important advantages. While being materially more compact than existing units so as to permit one-man portability and operation, the unit has a greatly superior performance. Its pressure diffuser prevents pressure gas from boring through the fuel, thus improving the action of the pressure system. The fuel nozzle substantially increases the distance the flame is thrown by eliminating eddy currents as occurred in prior art nozzles. The electrical, spark, ignition system, by virtue of its quick action and reliability, is far superior to the resistance wire or cigarette lighter-type ignition systems of the known flame throwers where oil coatings or any considerable winds rendered ignition unreliable and therefore dangerous. The present ignition gas system with its pilot ignition arrangement assists the spark ignition in providing safe, dependable and immediate ignition at all times and under any conditions. The trigger valve forming part of the ignition gas system contributes to the effectiveness of this system without adding materially to the weight or complexity of the unit. The ignition operating lever with its safety lock affords simple and immediate control of the various ignition steps while preventing unintentional, accidental ignition. The multiple tank arrangemnet is unusually compact and, together with the carrying pack, lends itself to being carried close to the operator's back yet assists in facilitating speedy putting on and discarding operations.

Evidently, various features of the invention may be used individually instead of combined, according to prevailing requirements. With larger or different types of flame throwers, for example, the gas burner chamber, the ignition system and the gas cylinder may be located at separate points at some distance from each other.

I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described as various modifications within the scope of the appended claims will readily suggest themselves to a person skilled in the art.

I claim:

1. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle and a pilot chamber communicating with said gas chamber, and an electric spark ignition system operatively associated with said pilot chamber.

2. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to one end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle, a jacket surrounding said gas chamber and communicating therewith, and a pilot chamber communicating with said gas chamber, an electric spark ignition system including a spark plug extending into said pilot chamber, and means for supplying ignition gas to said pilot chamber and, through said jacket, to said gas chamber, whereby to ignite the gas in the pilot chamber and, by the flame thus produced, the gas in the gas chamber.

3. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle, a pilot chamber communicating with said gas chamber, and an ignition gas cylinder secured on said barrel, and an electric spark ignition system including a spark plug extending into said pilot chamber and a spark generator housing secured on said barrel, said housing including a base forming a socket whereby to support said gas cylinder.

4. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle, a pilot chamber communicating with said gas chamber, and a trigger valve arranged on said barrel, said trigger valve comprising two valves, one of said valves controlling the flow of ignition gas, the other one of said valves sealing the stem during such flow, a narrow passage in said trigger valve for reducing the pressure of the ignition gas and means for operating said trigger valve, and an electric spark ignition system including a spark plug extending into said pilot chamber.

5. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a

stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle and a pilot chamber communicating with said gas chamber, and an electric spark ignition system including a spark plug extending into said pilot chamber and electric spark control means arranged on said barrel.

6. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle, a pilot chamber communicating with said gas chamber and ignition gas control means arranged on said barrel, an electric spark ignition system including a spark plug extending into said pilot chamber and electric spark control means, and means mounted on said barrel for first operating said spark control means and thereafter said ignition gas control means.

7. A flame gun, particularly for use in a portable flame thrower, comprising in combination, a flame gun barrel, a nozzle for discharging a stream of fuel under pressure secured to the end of said barrel, an ignition gas system including a gas chamber surrounding said nozzle, a pilot chamber communicating with said gas chamber, and ignition gas control means arranged on said barrel, an electric spark ignition system including a spark plug extending into said pilot chamber and electric spark control means, and a safety trigger mounted on said barrel and including an operating lever adapted to operate said spark control means, and only thereafter said gas control means, and a locking lever for locking said operating lever except during the operation of the flame gun.

8. A flame gun, particularly for use in a portable flame thrower, comprising in combination,

a flame gun barrel, a fuel valve secured to one end of said barrel and a nozzle for discharging a stream of fuel under pressure secured to the other end of said barrel, said nozzle including a long converging passage, a short straight passage and a diverging orifice, an ignition gas system including a gas chamber surrounding said nozzle and a pilot chamber communicating with said gas chamber, and an electric spark ignition system including a spark plug extending into said pilot chamber.

WARREN C. GRAHAM.

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